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SCHOOL BUILDINGS

WALTER H. PARKER

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SCHOOL BUILDINGS

By
WALTER H. PARKER
A. A. I. A.

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PREFACE

The purpose of this publication is to familiarize those interested, architects, schoolboards, instructors and students, of the requirements and the solution of such requirements, in the successful planning of school buildings. There is no claim to originality in any part of the work, there being at the present time many able authorities on school buildings in this country and in others, all of whom agree upon various theories and the practical application of such, to the extent that certain practice has been arrived at, the derivation of which may be readily retraced by any thinking individual familiar with the subject and having at his disposal all of the works upon the subject.

Where statements are made herein, they are based upon the composite standards of practice as advocated by the various authorities. The book is namely a memoranda reference book, for those interested, and as such, contains information readily found in brief, eliminating miscellaneous detail.

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INTRODUCTORY

There is no division of public or semi-public buildings that has received more theoretical study and the practical application of such study than the public school, especially in the larger cities. In less populated districts and in small towns, various makeshifts are frequently spoken of as educational edifices, the failure to build something creditable being attributed to the architect's neglect to insist upon what he believes to be the correct solution of the problem, and partly to his seeming inability to overcome certain unfavorable local conditions entirely out of his realm of influence. However, in the more thoughtful communities, new educational buildings are now approaching a higher degree of efficiency, due to the advancement of ideas of the architects themselves, and to the growing interest that the public in general is taking in municipal and civic improvement. Too much thought upon the principles of planning good construction and environment cannot be spent upon buildings whose occupants are unconsciously absorbing everything about them.

The building itself should be so designed that it will be safe, comfortable and convenient for its occupants, and arranged so that it may be economically administered and kept clean. It should be as near fire-proof as possible.

FRAME BUILDINGS

Little may be said concerning frame buildings, as their use is rapidly being dispensed with, except in the scattered districts, or where suitable materials are too expensive to use.

It may seem useless to devise extensive fire protection for such buildings, but burnable as they may be, it is possible to design them in such a manner that they may be emptied in a very short time by suitable corridors and the proper number and location of stairways. Fire-escapes are, theoretically, of valuable assistance, and in some States are required by the law, but their inefficiency may be readily demonstrated by the excavation of the building under normal conditions, let alone a similar performance when excitement, fire or smoke or other unusual elements prevail.

Every two-story building containing more than six rooms should have, irrespective of fire-escape, two well lighted stairways, located at each end of the building if possible, and opening at grade entrance, in addition to light and ample corridor space.

FIRE-PROOF SCHOOL BUILDINGS

A fire-proof building is one composed and built up of entirely fire-proof materials throughout, including every material used in its construction or decoration. There are very few fire-proof school buildings, strictly speaking, but there are many whose fire risk is reduced

to a minimum and which for all practical purposes furnish adequate protection to its inmates, and which may be called fire-proof.

From fire-proof to combustible, buildings may be constructed at all different stages and degrees of efficient fire-proofing. For school purposes and the economical disposition of municipal funds for the purpose of fire and panic protection, school buildings need be of fire-proof construction only to the extent that the inmates of the building are protected until they may have had reasonable time to leave the building, and sufficient to guarantee a depreciation in damage to property of not more than 10 per cent (in the event of outside protection being available). The above protection will be found sufficient; in fact, ample for all practical needs. In other words, a building whose protected frame work is concrete or steel, with brick, terra cotta or concrete walls, floors and roof terra cotta, concrete or metal lath and plaster curtain and partition walls, metal or concrete stairs of ample width and number, will be sufficient to meet the above requirements. Add to this metal or metal covered trim throughout, metal furniture, etc., and the entire building would be fire-proof throughout, not only from within, but from without.

All school buildings should be built with fire-proof walls, and all corridors and stairs should be of fire-proof construction. This would insure a reasonable protection against injury to inmates from fire and panic, and with the other customary fire protecting apparatus usually provided for should be sufficient

to protect the building, in all probability, against great damage. This type of building or modification of it, is certainly good and safe enough for the average community. Some of the new school buildings recently erected in San Francisco are similar to the above type, and others go one step better in that the entire first floor, including the ceiling (which is also the second floor) is made of fire-proof materials and in all cases the partitions are protected with metal lath and the customary plaster, in preference to the wood. There is no particular objection to a wood floor for school buildings, as there is little danger of fire reaching it from floor or ceiling, and it will not readily burn of itself. However, in a building with wood floors, the ceiling and walls of the heater room should be fire-proofed, or better yet, the heating apparatus removed to a separate building.

There is a common belief among some that a concrete building is fire-proof, and it is as far as the concrete goes, which is usually the shell only, the partitions, roof, trim, etc., being of wood, and, of course, subject to attack from without as well as from within by fire, as in any other so-called "fire-proof" building. A concrete building is no more fire-proof than a brick one of the same construction. Concrete, however, is one of our most accessible and most durable building materials and is being used plain or reinforced, as the case may be, to a great extent in the construction of school buildings.

The following classification may be of interest, as it embodies every kind of a school structure in degrees,

from the commonest frame building up to the absolutely fire-proof building.

CLASSIFICATION OF BUILDING

"D" Burnable Buildings	1—Frame. 2— " plastered on exterior over metal lath. 3— " veneered on exterior with brick. 4—Brick, concrete (wood interior partitions and floors).	
"C" Fire Resisting Buildings.	1—Brick, concrete or terra cotta.	1—Brick, concrete or terra cotta bearing partitions. 2—Wood floors, partitions and fire resisting roof.
"B" Fire-proof Building (so called).	1—Brick, concrete, terra cotta with steel frame.	1—Brick, concrete or terra cotta bearing partitions. 2—Brick, concrete, terra cotta or metal stud partitions, metal lath. 3—Concrete or terra cotta floors and roof. Wood trim and finished floors.
"A" Fire-proof Building (absolutely).	1—Protected steel or concrete frame.	1—Brick, concrete or terra cotta curtain walls. 2—Concrete, terra cotta or metal stud partitions throughout. 3—Concrete or terra cotta floors, roof. 4—Metal lath and plaster throughout. 5—Metal trim throughout.

COST OF SCHOOL BUILDINGS

The cost of school buildings, or any kind of building is dependable upon local conditions, including the cost of both labor and material, which will be different for each locality. No classification or cost basis is of great value, and it is usually found that a fireproof building or one semi-fire-proof, will cost more than one that is not, although the contrary can be cited in a few cases, due to the exceptionally low markets of some kinds of material.

Buildings are erected at a less cost in the East than in the West, being nearer the centers of available material and cheaper labor; and costs per pupil, costs per class room or cubic contents of a standard type of building will compare there very satisfactorily. However, on the Pacific Slope, and in the smaller cities, buildings under class "C" (see page 10) will rarely be completed under a cost of 12½ cents per cubic foot, and those under class "B" and "A" still more per cubic foot.

In estimating the cost upon a cubic foot basis, the total cubic contents are taken from the grade up to total height of building if same has a flat roof, or from grade up to one-half the pitch if the roof be other than flat. Figuring on a cubic foot basis is only approximate, but such computation is useful on account of its simplicity and will often save much time by confining the designer to conservative limits if his unit cubic foot cost price is reasonably correct.

A better way to arrive at the cost of proposed

school building is to segregate each trade called for in its construction, and estimate them separately, the total, plus contractor's profit, being a fair estimate of its ultimate cost.

ARCHITECTS

In the largest cities of the United States, the designing and superintending of construction of school buildings is done by the municipality or special departments, under the control of the so-called "School Authorities" of the present time, Wheelwright of Boston, Snyder of New York, Ittner of St. Louis, Perkins of Chicago, etc.

These men have, at some time, been at the head of one or more of the various departments which go to complete any building; the designing, planning and superindendence of the building itself, as well as its mechanical, heating and ventilating systems, which require competent engineers and subordinates.

Other large cities and all of the smaller ones, on down to the vallages and towns, employ architects to do their work for them, either entire or in part, to the extent that in almost every large locality there can be found architects who are fitted for this kind of work, schooled by extensive study of the best examples of school structures throughout the country, and of the theories and practice involved in modern planning, along with such personal experience they may have had with their own work. Any architect of ability and experience can design and superintend

the construction of a modern school building, it is true, the result depending upon his familiarity with the subject, and his ability and skill in handling it. It is well, however, that he may have the aforesaid qualities before undertaking any large permanent improvement.

BUILDING SITE

The conditions affecting the site of a school building are variable, depending principally upon the size of the city or town, its relation to land values. Smaller centers of population are more fortunate in this respect as it frequently happens that from half to an entire block may be obtained for educational edifices, while in New York school buildings are built of some height, with play grounds on the roof, for economic reasons, however, and not by choice.

It is highly desirable to locate a school building on as large a lot as possible, as an abundance of light and air has great influence upon the health and disposition of the pupils. The site should be remote as far as possible from congested railroad centers, dangerous crossings, factories, and other distracting influences. Play grounds will be required for both sexes; there seems to be no limit to their size, also no definite rules for a minimum and maximum. If some space in front of the building may be spared for grass plots, trees, parking, etc., so much the better, as the charm of any edifice is increased or diminished by its surroundings. Public school buildings, especially those

provided with assembly halls, are rapidly becoming the centers of the social intercourse, due to the advancing ideas of the American people, and as such, are entitled to the most conspicuous location available for such purposes.

EXPOSURES

No universal definite rules for exposures to class rooms have been found, for in some localities conditions may reverse otherwise desirable solutions to the problem of exposure for class rooms. In some localities where the sun is very intense, north and east light have been used whenever possible, eliminating sunlight entirely, and with very desirable results.

Whatever preference is given for exposure, it may be said that it is generally impracticable to have each and every class room with the same exposure, although schools have been built upon that basis.

The best results will usually be found by placing the building so as not to coincide with the points of the compass; otherwise a room on the north side, if lighted from that direction only, is entirely cut off from the sun, while the rooms with a south exposure may receive so much sunlight as to be uncomfortable in warm weather. By the above arrangement, east rooms will get some sunlight during the day, and a frontage which will make the southeast rooms the most desirable, the northeast and the northwest next, and the southwest possibly the least desirable of all. These distinctions should not be carried to extremes,

however, but in choosing a site they may be kept in mind.

If the lot has already been provided, school authorities should give their architect their preference as to the exposures with reference to class rooms, and should be satisfied if he follows their desires to a reasonable extent, as he has many things to keep in mind of equal importance in the solution of the entire problem.

PLANNING

In most buildings the controlling elements are those relating to planning, equipment and construction; the principal parts being in this particular case the class rooms themselves and communications, with as many secondary rooms of such size as to accommodate the purpose for which they are intended. In planning, the exterior need not be seriously considered (except unconsciously, as it invariably is when handled by those fortunate enough to see in elevation and feel in plan), but in order that the finished building may harmonize with the surroundings, and before actual working drawings have been started, some study should be made of the grades, exposures, approaches, even sky line, in some cases, and other physical conditions that may make or disfigure architecturally, an otherwise correctly appointed building. It is well to recognize the fact that good proportions and lines of any building do not depend upon its cost, and the result, if well studied, can be harmonious to the sur-

roundings, and consistent with the materials available; in other words, an attractive building need not necessarily be an expensive one.

So-called one-story buildings are becoming very popular, especially in buildings of not more than sixteen (16) rooms, and quadrangle effects are much sought after. Such an arrangement has many advantages, especially in mild climates, but will not be found as economical in construction, or as convenient of communication as buildings more compact.

A compact plan is one without waste space. If a ten (10) foot corridor is wide enough for the purpose for which it is intended, one twelve (12) feet wide is waste. If class rooms open from one side only of a corridor, where the corridor is of sufficient width to accommodate class rooms on both sides and still be properly lighted, such an arrangement is not economical.

The size and value of the property will usually determine the type of building best suited. An important item is the possibility or probability of additions which must be made at some later date without materially interfering with the arrangements of a good plan, or disfiguring a pleasing exterior, either present or future. Often a little more earnest study on the plan with this in view, will vastly simplify conflicting elements otherwise manifesting themselves in concrete form in the future.

In arranging the plan, the size of the lot is to be kept in mind, the proposed cost of building, number of floors, kind of construction and the requisite areas

of all the various departments to be incorporated therein, which are to be arranged conveniently and economically.

ASSEMBLY HALLS

Not all grammar schools require these, although they serve varied functions, being usually planned to accommodate more than the maximum number of enrolled pupils, and are often in demand for meetings or entertainments outside of the regular school program. It should be well determined if the proposed new building should have an assembly hall, as its cost is considerable both in erection and maintenance. The amount of regular use and funds available should determine whether it is advisable.

If the assembly hall is to be included in the plan, the entire scheme will be materially affected by its location. In the large schools such a room is invariably required; in fact, any school containing more than eight rooms may be considered as requiring one. It is located preferably on the first floor—not for economic reasons, however, but for the fact that it can be more readily reached without climbing stairs, and the exits to the grades may be more effectively placed. The additional height of this room, its large size, the problems of heating, ventilating and lighting, the long unsupported spans over ceiling, cost, etc., have great influence upon its location with respect to other parts of the building.

Assembly halls are used in two different ways:

1st. For the school proper; of sufficient size to seat, approximately, all of the occupants of the building at one time.

2nd. For the use of the public and the school together, and of a size much greater than the one first mentioned, having correspondingly greater stage capacity.

Either class may have fixed seats, but opera chairs or seats (other than class room desks and seats) will be required for auditorium in class 2nd.

ASSEMBLY HALLS—LOCATION

In many of the more recent schools the auditorium is placed on the ground floor between two wings, or the central part of an E-shaped building and of such size as to accommodate all of the pupils at one sitting. In any case it should be located with careful respect to its ultimate use; in other words, if used for public purposes, a more convenient level would not be found than on the ground, or possibly first floor. If the building had three or more floors and the assembly hall was of a size only to include the occupants of the school, it might be more logically placed on the second floor, where it would be nearer the center of communication from all floors.

One advantage of locating the Assembly Hall near the ground, is the adequate facilities that may be obtained for exit purposes, as the higher up it is placed greater and correspondingly less efficient means of fire escapes and exits will be required.

ASSEMBLY HALLS—STAGE

A stage or platform of sufficient area to accommodate two classes will be of the average size, and should be elevated two feet or more, depending upon the depth of the Assembly Hall. Ante-rooms adjacent are desirable on the same floor level, if possible, as that of the stage.

ASSEMBLY HALL—LIGHTING

The assembly hall should have natural light from one or both sides in addition to any overhead lighting, but there should be no windows facing either audience or speakers, especially the former.

The windows for an assembly hall need not be so liberal in proportion to floor area as required by a class room, and some skylight lighting is not objectionable; in fact, the customary rules for class room lighting may be ignored in this respect.

The height of windows above the floor is usually greater than that in class rooms, and the grouping may be obtained in various efficient ways, cross lighting being desirable.

When not feasible to arrange the auditorium so that light may be obtained from both sides, skylights may be introduced, but the latter should not be relied upon entirely, as outside light of some kind is imperative.

ASSEMBLY HALLS—EXITS

Exits to grades should be located independent of

those opening into corridors, so that the room may be emptied in a reasonable length of time. When the room is located close to the ground this may be accomplished very readily by placing at the exits double glazed doors around the room at various intervals, in addition to those opening into the corridors. Exit doors are fitted with automatic door openers which operate by means of pressure against them. In all cases they should open out.

ASSEMBLY HALLS—SEATING

For the approximate number of seats that may be placed in an assembly hall, 6½ square feet of floor area per sitting may be taken as equivalent to each sitting, including aisles, etc. Opera chairs are made of different widths, 20 inches being a standard from center to center, of arms, and as most seating of this kind is laid out in curves of different radia, the manufacturers of such articles make chairs of fractional widths which will bring the seats at the aisles even on both sides, and such variation from the standard used will not be enough to be noticed. The rows of seats are placed back to back, 2′-6″ being a minimum.

Where opera chairs are used, the floor to assembly hall is often concave or sloping, as this feature will give better results in enabling each individual to see the stage without discomfort. It will also increase the cost of construction somewhat.

As it is often desirable to have some large area of level floor space, preferably in the assembly hall, a

combination of the two may be utilized in having the seats movable from the stage back to half of the depth of the room, and from that point fixed seats being used on an inclined or concave floor. This arrangement will be found satisfactory, as the seats most remote from the stage are those that have to be raised above those preceding, in order to facilitate the correct lines of sight.

ASSEMBLY HALLS—GALLERIES

Galleries or balconies are not objectionable to increase the seating capacity of an auditorium when proper provisions are made for ventilating them; otherwise the heat and foul air will make them uncomfortable. They are always arranged with seats stepped up towards the rear to assist in obtaining the proper sighting. Aisles should be sloping and free from steps if possible.

STAIRWAYS

Stairways in school buildings are rarely of one run. The most common form are those that start from a floor, have a landing at about half way and continue back again to the floor above. Winders are never used.

The width of stairs varies in most cases and for a double run will be anywhere from 4½ feet up to 6 feet, which dimensions may represent a minimum and maximum width. As most corridors will average from 10 to 12 feet in width and as it is usual to have

the stairs at both ends of corridors, it will be readily seen that each run of stairs is half the width of the corridor; and it is stated by one authority that for a run of stairs, anything greater than six (6) feet is wasteful. It is better to provide more stairways.

The steps themselves are of easy climb, the treads being approximately twelve (12) inches in width and the rise never over seven (7) inches in height.

The stairs should be of fire-proof construction their entire height and in many cities such construction is regulated by local ordinances. It matters little what material is used in their construction as long as they are fire-proof, although concrete is being used extensively. When such is the case, the balustrade may be made solid, curving at the landings, and doing away entirely with newel posts and forming a smooth rail from basement to the top floor without breaks of any kind. Such a balustrade is strong and free from the numerous surfaces presented to catch dust, found with the more antiquated balustrade with iron or wood balusters. The treads may be protected by any one of the numerous metal and composition safety treads, which will form a still more important function in forming a surface that will prevent slipping and one that will wear well.

Ample lighting should be obtained for all stairs, especially at the landings, as when provided for here, light will be thrown on both runs of stairs and partially down the corridors.

Most school buildings of any size will have two stairways from the first floor to the ones above,

whether or not in connection with entrances. In the latter case the entrances themselves should be ample and free from obstruction. Many entrances have vestibule doors, the balance of the opening being taken up by partitions which might as well be substituted with an additional glazed door, used or not as desired, but convenient should the occasion arise.

CORRIDORS

Corridors are proportionate in width to the number of pupils passing to or through them, and for the accommodation of any articles that may be placed in them. "They should receive natural direct light and ventilation from outside windows; a long corridor lighted wholly by borrowed light, no matter how abundant, invariably produces an effect of confinement which is depressing. Windows or stair landings are very serviceable, as they shed their light far into the corridors. There is, of course, no objection to borrowed light as an accessory to direct window lighting; but it must be remembered that glass transoms and glazed doors, though they afford light, give no air to the corridors and cannot take the place of windows opening into the outer air."

That corridors should be any particular width is arbitrary, but in school buildings of a more or less typical size, they may be approximately of the same width. There seems to be no logical reason why a corridor serving four rooms only, should be the same width as one that opens into eight class rooms

or more, or that the entrance "loggia" may not be 18 or more feet in width. Eight feet might be considered a minimum width for main corridors, and twelve feet wide an average. One authority on the subject states that a greater width than 12 feet is a waste of room and therefore, poor planning. It is certain that no typical corridor need be wider than that dimension to comfortably fulfill its purpose.

Corridors on the second floors need not be of the same size as those on the lower, but in most buildings are so for economy in construction and general appearance.

A type of corridor in California called a "Cloister" is very popular in one-story buildings, and in some cases in two-story buildings. It is left open in summer, a desirable feature in extreme localities and one which eliminates the need of mechanical ventilation features to a certain extent as far as the corridor is concerned, as the air may circulate unrestricted. In most cases, however, a "Cloister" consisting of a repetition of open arches should be enclosed with sash glazed with wire glass or storm sash in the severe winter months to keep out the weather. This will also mean additional heating if the "Cloister" is to serve as a corridor, but not so many changes of air will be required as in class rooms. "Cloister" floors are generally of cement or similar material.

The floors to inside corridors may be linoleum over cement or wood, terrazo, tile, composition, etc., depending upon the kind and construction of the building.

A foot warmer will be found necessary near entrances in the more severe climates.

The walls to corridors may have enameled brick tile, "Keene's" cement or other durable wainscot, as near water-proof as possible. Wood should not be used as a substitute. Above the wainscot, walls and ceiling may be left smooth for tinting or painting.

CLASS ROOMS

Typical class rooms are usually 24 feet by 32 feet (24x32). They may be any size, it is true, but that size will accomodate 56 primary or 48 grammar school pupils—all that one teacher can properly handle, according to opinions of most educational authorities. A width of 24 feet will also admit a sufficient amount of light along the wall opposite the windows, and the length of 32 feet will permit easy sight of the blackboard behind the teacher's desk, and will not be too far to readily hear in the farthest part of the room. In most of the best public school buildings throughout the country, this size, or approximately this size is used, and may be considered a standard.

Size of Class Rooms in Grammar Schools

Boston	23′ x 29′	42 pupils
New York	22′ x 30′	40 pupils
Chicago	24′ x 34′	48 pupils
St. Louis	24′ x 32′6″	48 pupils
San Francisco	26′ x 32′	48 pupils

The height of class rooms vary slightly, depending

upon its size, 12'-6" to 13'-6" being the customary height.

One ample door to corridor, 40 to 44 inches wide, should be provided near the teacher's end of the room, alike for entrance and exit. Such a door is wide enough to allow two files to pass in or out at once, and is under the teacher's eye and full control. A large single panel of opaque wire glass will allow light through the door and is practically indestructible. Six rows of eight desks each, from front to rear, can be conveniently placed in a room 24x32 feet and seven rows of eight deskes each, for the primary grades. Widths of from 27 to 30 feet are common for class rooms in the United States, but do not represent the best practice, the tendency being to decrease the size of rooms with proportionate teaching facilities.

TEACHERS' CLOSET

A combination book case, closet and wardrobe is usually built into the wall in class rooms as near the teacher's desk as may be practical. It need not be over 12" to 18" in depth, and in many instances it can be built into the wall and project into the room not more than 6", or if flush with the wall so much the better. The case is from 3'-0" to 4'-0" long and contains shelves, cupboard, two drawers, the book case being fitted with glass doors. Corner closets are built in some rooms, but disfigure the appearance

of the room and do not lend themselves as well to book shelves, etc.

LIGHTING OF CLASS ROOMS

The lighting of class rooms occasions more discussion and theories than any other controling element in school design, is much discussed, and often very positive conclusions are arrived at by those who are not sufficiently familiar with both theory and practice. It must be remembered that too much light is not a bad fault, for even if incorrectly placed it may be closed over with shades when not desired, while too little light is a fault that cannot be remedied.

It is almost universally agreed that class rooms should be lighted from one side only, unless of exceptional width, a partial exception sometimes being made for corner rooms, which may have windows in the end at the rear of the desks, opposite the teacher's platform. When windows are so placed their purpose primarily is for securing some sunlight in a room that it not otherwise arranged to allow an abundance of this most necessary adjunct to ventilation and sanitation.

If possible, class rooms should have sunlight at some time during the day, and if such light be annoying at times, it may be very easily removed by drawing a shade over it.

The best practice favors a blank wall opposite the teacher and pupils, so as to avoid the glare in either's eyes. When windows are placed in the rear of the

room, the pupils in the two or three rearmost rows sit in their own light from such windows, which is unpleasant, and often injurious to sensitive eyes. The customary light for a school room is that which comes from the left side and from slightly in front of the pupil. Light from "over the left shoulder" is often advised as the best for reading; but it is bad for writing and drawing, as it may cast the shadow of the body across the work on the desk.

In some of the most modern school buildings, skylights are provided for in the ceiling, and light from this source used independent of the windows elsewhere; but this method is not practical in most cases, as school buildings are not usually of one story in height. It may readily be seen that skylights are impossible for a building of, say four floors or more, excepting for the topmost floor. Overhead lighting may be the ideal light, and future developments may revolutionize the present lighting ideas to some extent in the smaller buildings where such lighting may be taken advantage of.

The area of light for class rooms is approximately equivalent to one-fifth (1/5) of the entire floor area.

WINDOWS (Class Room)

Windows are not usually less than three and one-half (3½) feet above the floor, as light lower than that level is useless, and they should extend to within one foot of the ceiling, as the higher up they run the more efficient is the lighting. In some schools windows ex-

tend to within six (6) inches of the ceiling and interfere somewhat with the cove ceiling that is usually run around a class room; but even this may be overcome without serious defect.

Shadows may be eliminated to some extent by narrow mullions, and the most ideal results will be obtained by a mass of windows closely grouped together, as those found in factory construction, a studio, or windows similar to those found in the New York schools of more recent date. This arrangement does not adapt itself to some styles of architecture and satisfactory results may be had with other arrangements, provided windows are not placed too far apart and are of sufficient area. These requirements hold in general for grammar schools, but high or secondary schools **do not** require such exact conditions, due to the fact that students are not confined to any one room during the entire day and are fewer in number per class room. Bilateral lighting is permissible only in wide study rooms over thirty feet in width.

Architects are occasionally seriously hampered by arbitrary opinions of school trustees, often well taken, but not so vital as others having equal importance in the whole solution of the problem. In fact, there are trustees who have such decided opinions on this subject that they have been known to entirely discard a carefully studied solution to their problem because the fenestration was arranged differently from their own ideas.

For grammar schools it will generally be found sufficient for those in charge to see that approximately

one-fifth (1/5) of the floor area is in glass and that the windows are fairly well grouped.

CLOAK ROOMS

Cloak rooms or wardrobes in grammar schools are for the purpose of providing hanging and storage space for pupils' wraps, rubber shoes, etc., and are usually located at the side or end of a class room, preferably the latter, as a window may be more readily placed in the wall at the end of that room, a very important convenience. Often so-called ventilation is obtained in them by air passing through a screen in the lower half of cloak room doors from class rooms, and thence up to the ceiling of the cloak room. This may not be strictly termed ventilation, as the air has been used once in the class room, but its velocity will be greater in the latter room and such as it is, will assist in drying out garments that may be damp, etc.

Whether pupils should enter the class room first and then pass into the cloak room, thus allowing the teacher to keep surveillance over those passing therein, and practically eliminating stolen articles, etc., or whether the pupil should pass into the cloak room first, leaving wet and muddy garments in the wardrobe before entering and disturbing the room, is a subject under discussion in all communities, and one which may well be taken from either standpoint. Possibly the former arrangement is the better, especially in the primary grades, as it is thereby impossible for a pupil to remain in the wardrobe without the teacher's

knowledge. In planning the school, this discussion may be eliminated entirely and either system used, or both, by merely providing a door at the entrance to wardrobe from corridor, as a means of communication, the door being locked if desired.

The size of cloak rooms should not be less than four and one-half (4½) feet in width, and are usually in length, approximately, twenty-four (24) feet (the width of the class room). When such is the case a width exceeding 5′-0″ is a waste of space.

Coat hooks should be spaced on each wall about 12″ to 18″ apart, alternately, at two different levels. If numbered, each pupil will readily know the location of his own hook and may pass without delay through the cloak room. Height of lower hooks—kindergarten, 30 inches from the floor. Height of lower hooks, —upper grades, 44, 48 and 52 inches from the floor.

Where mechanical ventilation is used, the two doors opening into the cloak rooms from class room have heavy galvanized iron screens in lower panel; these doors will be about 2′-6″ wide.

Patent Wardrobes

There are other systems than the above, used for wardrobes, some of which have been found successful under certain favorable conditions. Racks have been placed in the halls in some schools, thus eliminating the so-called "cloak room" entirely, but their use has many disadvantages, the least of which is the necessary unkempt appearance of the corridors so used.

The capacity of cabinets with rolling fronts is not

to be compared with the average sized cloak room, and the sanitary arrangement is not equal to a suitable room with a window.

Outside of the functions of a wardrobe, namely, to conveniently care for the pupils' wraps, provision must be made for suitably ventilating it and shelves provided for lunch boxes, racks for umbrellas, etc.

Terrazo, composition, or other waterproof floors will be found desirable in wardrobes.

BLACKBOARDS

There are several kinds of blackboards, natural (slate) and composition, used extensively in school buildings, as well as numerous paint products which have their usefulness, but can in no way be considered as blackboards.

Slate is by far the most durable, and in the long run the most economical as well, weather conditions having no effect upon its surface, which cannot always be said of the composition blackboards. The latter are usually built up on felt board, about one-quarter of an inch thick, and finished with a composition surface less than one-sixteenth of an inch thick; this surface resembles slate in appearance and texture and supplies a satisfactory surface in most particulars. It is possible that dampness may creep into the backing and cause it to buckle, thus injuring the surface. The manufacturers of the composition boards give a ten-year guarantee on their product, which means that they will replace same if so damaged. Preparation

for these boards consists of a smooth wood backing, to which they are glued on with clamps. Air spaces, where the glue does not adhere perfectly, may be detected, the hollow sound made by rapping the surface with the knuckles. The boards come in different lengths, 12 feet being common, and in widths of 3′-0″, 3′-6″ and 4′-0″.

Another board which may come under this classification consists simply of a "skim coat" plastered over the wall plaster beneath, and is of a similar quality and texture as that just described for board backing. It is also less than one-sixteenth of an inch in thickness, and if put on by its manufacturers smoothly, is just as good a surface for chalk. Metal lath is usually used for the plastered surface in connection with this board to reduce the cracking (due to building shrinkage) to a minimum.

The heights of blackboards are usually as follows:

Primary grades .....26″ from the floor
Intermediate grades ....30″ from the floor
Higher grades .....36″ from the floor

The height of the board itself should be 3′-6″ for the lower grades and 4′-0″ for the higher grades.

Often the blackboards behind teachers' desks extend still higher to enable chalk work to be readily seen from all parts of the room. The cost of blackboards is variable, depending on sizes, freight rates, areas, etc. In general, slate may run from 20 to 35 cents per square foot, and composition boards 15 to 25 cents, in place on the wall.

BLACKBOARD TRIMMINGS

Trim for blackboards consists of wood or metal chalk rail, grooved to form a trough to catch the chalk dust and hold crayon, pointers, etc. Where vacuum cleaning apparatus is installed this trough may have apertures to remove the dust, and covered over with screening. The usefulness of the arrangement is doubtful, however. At the top of the board a wood strip forms the trim, usually grooved like a plate rail, to hold cards, pictures, etc. (and more or less miscellaneous dust).

PRINCIPAL'S AND TEACHERS' ROOM

A room for the principal, also one for the teachers, is usually required in every school building. A room containing approximately 240 square feet will be sufficient for each. They may be fitted with lavatories and a toilet in the teachers' room, or both. Wardrobes should be built into the walls of the teachers' room and a gas plate, concealed in a cabinet, may be convenient. The principal's office should have a supply closet, wardrobe, bookcase, and if a large school, a private office will be required, 120 square feet being a fair minimum size. The location of these rooms should be as near the entrance as convenient, especially the principal's room, and also near the center of communication.

TOILET ROOMS

Toilet rooms for grammar schools are generally

placed on the ground or basement floor, where they can be reached from the play yard as well as from the building. They should be well lighted and ventilated and in some instances a separate building connected to main building by a cloister or covered corridor will be found admirable when plenty of ground area is obtainable. Wire glass will be found suitable for the glazing of windows. Tile, cement or composition floors are used (never wood), sloping slightly to drain. The walls may be of any material excepting wood; hard burned or salt glazed brick being a suitable material. Cement wainscot or tile may be used when it is necessary to fur out the walls on account of dampness. The ceilings are of plaster. The number of fixtures required for toilet rooms will be variable. The Massachusetts rule is 2.25 fixtures for each class room 75 boys', 1.5 girls' and 33 lineal feet of urinal per class room. The above rule will be found ample. (See sanitation for fixtures.)

DOORS

Class room doors into the corridor should be from 3'-0" to 3'-6" in width, and glazed with opaque wire glass. The latter being a heavy plate glass with a metal wire woven into it and admitting light, but being of itself almost indestructible.

Exterior assembly room doors are usually double and always open outward to exit, being mechanically operated by pressure against them from the inside.

Doors from corridors to assembly room are double swing, not more than 2'-6" wide each, and not over

7'-0" in height; large or heavy doors are cumbersome to handle if used extensively.

Main entrance doors open out, except in connection with entrance vestibules, in which case they may be swung in and fastened against the wall out of the way, leaving the vestibule doors to be used in their place.

Wardrobe doors (from class room to wardrobe) are 2'-6" in width and are made with an iron ventilating screen in the bottom for ventilating purposes. The height of all doors need not be more than 7'-0".

FLOORS

Wood floors in class rooms are of first quality vertical grain pine or maple, the latter being used almost universally in assembly hall, gymnasium, domestic science room, laboratories, etc. Composition floors are being used as finish floors throughout some of the fireproof structures, and it is possible that in time they may supplant wood, even in buildings whose sub-floor is also frame.

Corridor, stair and vestibule floors may be of wood, composition, marble, tile, etc.—even cement in some cases. Cement or composition floors are used almost entirely for toilet, play room, furnace room, etc.

WALLS (Class Rooms)

Wall spaces, not covered by blackboard, may be plastered and tinted, or covered with burlap. Tile, Keene's cement, or any durable material may be used as wainscot below blackboards and around corridor walls; also around cloak room walls.

CEILINGS

Ceilings are 12'-6" to 13'-6" for class rooms. In corridors and cloak rooms they may be furred down to 10'-0" to allow concealed space for heat and vent ducts. Cove ceilings are desirable in such rooms as may lend themselves to treatment, as dust, etc. will not get into corners in places where it is difficult to clean, and the appearance of the room is also much improved with their use.

KINDERGARTEN

A large room, a small one, supply closet, wardrobe and toilet will be sufficient. The main room should take a sixteen (16) foot circle and the floor may be of linoleum, lined off as desired by the instructor. A teachers' wardrobe and bookcase will complete the arrangements. If the subject is an innovation to the community erecting the building, an ordinary class room will answer the purpose for some time.

SPECIAL ROOMS

In large cities, where a school physician is employed for vaccinating purposes or for testing the eyes and teeth of pupils, two small rooms may be provided for that purpose, a total area of 240 square feet being ample. They should be fitted with lavatory, cases, etc. The teachers' or principal's room may be used for the above purposes if the school is of small size.

Janitor's Room

A janitor's room is located on the ground floor and

should be provided with some outside light, store room, sink, work bench and closet space.

Engineer's Room

Schools of large size, where steam is used for heating and other purposes, require an engineer's room, containing lavatory and more or less wardrobe or closet space.

PLAY ROOMS

Play rooms are necessary for use in inclement weather, where there is no gymnasium. As much open space is desirable as is possible. Good light, and the same floor, wall and ceiling material as called for in toilet rooms, should be provided for. Drinking fountains are placed in each play room, which should be in close connection with the toilet room. In the large cities, play rooms for high buildings are placed on the roof for economic reasons, but the average school will have plenty of space in the basement or ground floor for such purpose.

DOMESTIC SCIENCE

Some form of domestic science is taught in most grammar schools, and if the school is of sufficient size, and a special teacher is provided for that purpose, more or less suitable space is required.

This space should be well lighted, and if cooking is introduced, work benches, gas plates, cupboards, dresser, sinks, etc., will be necessary. Sewing rooms

may be of any size, the ordinary class room being sufficiently large. (See domestic science for high schools.)

MANUAL TRAINING

Manual training is now taught to some extent in grammar schools, and provision should be made in a new building for that purpose. The arrangement may be as elaborate as funds will allow, from a single room and store room up to the model described as follows:

The room itself should be finished as nearly as possible to resemble a shop, with wood floor, high wainscot of brick, tile or cement and plastered ceiling. The location may be in the basement or ground floor and from 600 to 1000 square feet in area, depending upon the size of the school. A corner room, well lighted on both sides, is preferable. The room will contain possibly twenty-eight benches and stools, display frames, demonstration table and steps for instruction.

In addition to the room proper, a stock room (eighty square feet), long and narrow, fitted with racks or shelves, and connecting to the outside wall by window, will be necessary. A large teacher's closet (forty square feet) for storage of finished pieces, and book case similar to those in a class room, will be required. A sink, three feet long, and work rack of lockers should be included, the rack being used to receive pieces of work at different stages.

No machinery is installed in manual training room for grammar schools, as the raw material for this de-

partment may be delivered at the building cut up and ready for use.

GYMNASIUM

Gymnasiums are not provided in grammar schools unless they be of large size or in cases where little or no yard space is available. (See gymnasiums under high schools.)

TINTING OF WALLS

Pure white is a bad color for class rooms, or any combination of white and black, as both are considered cold and have a depressing effect, especially in rooms which are constantly occupied.

The ceilings of all rooms and corridors should be a light cream color, as that color is pleasing to the eye, and makes the room light and airy. The walls may be cream colored also, preferably of a slightly darker tone, or any warm grey color, avoiding strong tones of red, yellow or blue, or any combination of them. The wainscot under the blackboards may be of a still darker grey, as it will get considerable wear and more or less hard usage.

Water colors, tinting or oil paint, stippled to kill the gloss, are suitable for class rooms. In some cases enamel is used below the blackboards, a material that may be readily washed off and one that will stand considerable hard usage when put on over Keene's cement or other similar cement wainscot.

HIGH SCHOOL BUILDINGS

The same general problems have to be solved for high school buildings as those for grammar schools, and many others in addition, but fortunately many so-called "iron-clad" requirements may be materially modified, as the control of high school pupils is somewhat simplified, due to a difference in age and intelligence from that of primary pupils.

In high school buildings, smaller class rooms, 24x 32 feet, are often better adapted to some of the subjects taught, larger rooms being reserved for study hall, laboratories, shops and assembly hall, the latter often being used for a study hall, when not provided for otherwise. The introduction of manual training facilities, gymnasium, chemistry, and physics laboratories, commercial departments, domestic science, lunch rooms, etc., all require more rooms of various sizes to suit the purposes for which they are intended. Additional administrative rooms will be required, such as principal's office, teachers' rooms for both sexes, and one or more instructors' offices.

The average architect is not familiar with the miscellaneous equipment of high school buildings, and it is not absolutely necessary that he should be, but he must acquaint himself with the apparatus that will at some time enter into his building, even though its final installation be effected long after his connection with the building has been terminated.

Unfortunately, in most cities too little time is devoted to laying out the equipment for a new high

school before the plans and specifications for general construction are completed and building operations commenced. It is well worth while to devote as much time and study as may be necessary to lay out all school equipment thoroughly before it is too late to modify the general construction plans. Many cities have learned this too late and have been forced to install in their buildings equipment inconveniently arranged because of limited space, or in conflict with the structural details. The ideal way in which to approach this problem is, first, to prepare tentatively all plans and specifications for general construction, including building, heating, ventilating, plumbing, wiring, etc., then to locate on the same drawings and at the same scale, all of the more important pieces of equipment; lastly, to complete the general plans. This order of procedure avoids conflicts between structural details and equipment and permits the maximum utility of all space in the building. It also reduces to a minimum changes and alterations in structural details to accommodate equipment changes that cause delay and expense.

Cloak rooms and wardrobes may be eliminated with perfect success in high school buildings by substituting lockers either in the basement or corridors. The lockers—the metal ones preferred—may be arranged so as not to be in any way objectionable so far as appearance is concerned. In many schools the boys' lockers are located in the basement and the girls' lockers on the second floor corridor, in which case it will be found very convenient if the girls' toilet is located

also on the floor. Combination locks may be supplied to lockers which will not readily get out of order and will be found superior to locks with keys, in that they can not get lost.

STUDY HALLS

A study hall is incorporated in a great many high schools, either with or without an assembly hall. It is not a necessity in every case, as in modern high schools the assembly hall is used in that capacity as well as the library and unused recitation rooms during certain periods of the day, depending, of course, upon the system of instruction and discipline of the school. It is usually in size equivalent to two class rooms, but any size over and above that of a class room is sufficient.

ASSEMBLY HALLS

All modern high schools have these and the requirements will not differ materially, except for size from assembly halls as described under that title for grammar schools. (See page 17.)

CLASS ROOMS

A class room 24x32 feet will acocmmodate as a maximum capacity forty-two (42) high school desks. In many high schools, class rooms may be more correctly termed recitation rooms, as they are used only for that purpose and may be of any size, down to 20x28

feet in size. When so used, desks are not used at all, the furniture consisting of chairs with wide arm which answers the same purpose. Other schools will have some rooms fitted with desks, usually movable, and seating two persons per desk in straight back chairs, also movable. In such a type of school most study is done either in the assembly hall, study hall, library or elsewhere in recitation rooms not utilized during certain periods.

The size of class rooms, therefore, in high schools is dependable upon the system of instruction, but in an average number of high school buildings with study or assembly hall, a few rooms 24x32 feet or 26x32 feet in size, two or three smaller, 18x24 feet average, will be found sufficient for language, mathematics, history, rooms, etc., not requiring special fittings such as laboratories.

The lighting of class rooms is quite different for high schools, such exact quantities as required for grammar schools not being necessary on account of the classes being smaller in the first place, and second, and still more important, the system of instruction is different, the pupils not being required to remain in the same seat and in the same room during both periods.

Blackboards in high schools are usually of slate and the height above floor, three feet.

COMMERCIAL DEPARTMENT

In the commercial department the changes of the last few years have been most marked. It is now con-

sidered proper school practice to fit out the rooms as nearly as practicable along the lines that are adopted by industrial and commercial offices, thus furnishing pupils with the appliances that the present day offices will present as soon as they have completed their school work.

For the average high school, instruction in this department will consist of a typing room, often a closed partition of plaster wall and plate glass, the latter being quite extensive in area and facilitating supervision over that department without an additional instructor; a bookkeeping room, and one or more recitation rooms for stenography and lectures on business methods, etc.

Store rooms, numerous supply cases and cupboards will also be found necessary to facilitate proper instruction in these subjects, the arrangement of which —in fact, the total floor space occupied by the commercial department—will depend on the number of instructors and pupils interested in those subjects.

CHEMICAL LABORATORY

Chemical laboratories are usually located on the ground floor, a basement floor of the building, although the reason for such a location is rather indefinite other than the principal class rooms, etc., are first provided for and what space is left after they have been disposed of is given to laboratories, etc.

Such an analysis of planning is not the best and the laboratories may better be located on the top floor,

where gases, etc., are less likely to percolate through the building and where an abundant amount of light may usually be obtained.

As the chemistry laboratory is one department of the science group, its location is influenced somewhat by that of the physical laboratory and lecture room, which may be used for both studies.

The size will depend upon the number of pupils taught, 30 square feet per pupil being taken as an approximate space, but better results will be obtained by blocking off all articles of size that will be placed in the room, tables, sinks, etc.

A laboratory day consists of four or five periods, and the space for pupils' individual equipment should be, therefore, four or five times the working capacity of the laboratory.

The use of acids and destructive chemicals in the chemistry department plays havoc in time with wood and plumbing pipes, eating away and discoloring parts, so that it is impossible to keep the laboratory in a presentable condition. Glass may be used for the tops of the work tables, and though expensive, it may be obtained in almost any thickness and in either white or black opaque colors.

Stone of some varieties is sometimes used, also marble, either material affording far better wearing surfaces than the common wood tops usually found in smaller schools. Plumbing pipes should be lead lined, and all sinks should be porcelain lined to prevent acid from eating parts inaccessible, and whose condition is unknown, until some extensive damage is

done. The customary students' chemical work table is provided with two or more sinks, water supply, gas outlets, a combination shelf for acid-proof materials and supplies. Many stock tables do not provide toe space at floor and are uncomfortable to work at. They should be raised either above the floor or spaces left at different intervals to allow pupils to work close to the table.

Chemistry benches or work tables may be had from manufacturers and be single or double and of any length desirable. The size mostly used is the double bench, which is about 4½ feet wide and 10 to 12 feet long, requiring a working aisle of about five feet in width. The preference for tables of this type is to save room taken up by the aisle, and to simplify plumbing. Chemical hoods or fume closets should be well ventilated and should have plate glass sides. Where mechanical ventilation is installed in the building, they may be connected to the system. They are about eight (8) feet in height and of variable widths, according to the number of pupils to provide for.

It is possible in many cases to have the chemistry laboratory directly adjacent to the back of the lecture room, in which case enough head room will be found under the seating arrangement in that room to provide for abundant locker and store room area. As this space would be otherwise wasted, such an arrangement will be readily seen to be of great advantage.

CHEMICAL HOODS

A double chemistry hood or "fume closet" is about

52x32 inches in area and 7 or 8 feet high, plate glass windows in the front if flush with the wall, or on three sides when fixtures project into the room. It has gas and water taps on the counter and drawers and cupboards underneath, and is ventilated independently or in connection with a mechanical ventilating plant.

CHEMISTRY TABLES

These may be of different sizes. A double table 12 feet long and 4 feet wide, accommodates 16 students working in sections of eight. Such a table sets free in the room. A wall type half the size in length is also made for eight pupils, in sections of four. All tables have reagent shelves, sinks, water and gas supply on the counter and drawers and cupboards under, with name plates and locks. More elaborate tables have small chemical hoods for each pupil, glass top and reagent shelves, etc., the equipment depending upon the importance and funds at the disposal of this department. All tables should be solid in construction and of substantial material, as they will get considerable hard usage.

STORE ROOMS

A store room and some cases and cupboards are required in this department and often by a little ingenuity on the part of the architect the cases may be set into the walls so that they are flush with the same in the front, a much neater and more sanitary arrangement.

PHYSICAL LABORATORY

This room should be somewhat larger in size than the ordinary class room, should be located near or adjoining the science lecture room, and in addition to the room proper there should be an apparatus, balance, dark and store rooms, all of such size as is available. The main laboratory should be not less than 24x36 feet.

Laboratory tables are of quite solid construction with gas, electric and water outlets; tables seating from two to four will be the average fixture. A good arrangement would be aisles of two tables with sink and drip board between, and seating four pupils per table or eight pupils per row. A demonstration table of large size, and equipped with water, gas and electricity, will be required. Flush plate electric plugs should be placed in all tables and at various convenient places around the room; also a cut-out box with attachments for direct and alternating current for the more elaborate experiments.

Balance cases should be built into the wall, flush with wall surface if possible, and should consist of a glass sliding door and solid shelf upon which is placed the balance weights, etc. In some institutions a special room is provided, with dust-proof cases, where no air currents will circulate, but the above arrangement will be considered sufficient for the average sized high school. The apparatus room is used for keeping bulky apparatus and also for putting together and preparing experiments ready for demonstration, either in the laboratory or lecture room. It should

be as large as possible (10x12 feet, a minimum size) and fitted with plenty of shelving, cases, work counter, etc. A dark room is required in connection with physics laboratory, with sink, some shelving and electric outlets; also some store room space.

SCIENCE LABORATORY

Botanical and zoological science are taught in this room, 24x34 feet being a minimum size. The tables are about 54x24 inches and 30 inches high, each accommodating two pupils. The tops of tables should be glass, if possible, or hard maple with water outlets, one to every four tables. A large sink is also required, with drip boards on either side.

An aquarium, live cage, ice box and cases of lockers will be additional equipment, the extent of which will vary with the importance given to this department.

PHYSICAL GEOGRAPHY

This subject may be taught in the science laboratory in small high schools if of sufficient size. A separate room, about 24x36 feet in size, with delta table, is provided for in large buildings.

LECTURE ROOM (Science Group)

A lecture room is necessary in conjunction with the physics and chemistry laboratories and if of sufficient size may be used for lecture purposes for other studies than those two mentioned. The room must

be large enough to comfortably seat at least fifty, and should be large enough to seat more than twice that number if the room is intended to be used in connection with other departments for scientific lectures with a stereopticon. In the latter case, raised seats are arranged for as in a "clinic." The location of this room is important, as it must be accessible to corridors as well as to both laboratories. The platform for the seats are stepped up from the demonstrator's table 6 to 10 inches per step, the higher ones being in the rear of the room. Enough height will be obtained under the last few rows of seats to provide for considerable space underneath, which may be used to advantage for locker and storage purposes for chemistry or physics laboratories, if either directly joins the lecture room, The best seats are those of the opera chair type, with one wide arm that may be dropped down at the side when not in use. Some provision must be made for darkening the room at times, which may be accomplished by opaque curtains sliding in wood or metal groves, and operated by hand. Other equipment for this room will consist of a demonstration table similar to the chemistry bench, though longer and provided with sink, gas, water, electricity, etc.; also a cabinet for storing the slides for stereopticon, a case similar to a library card file and of sufficient size to take the negatives, being frequently used.

DOMESTIC SCIENCE (Cooking)

The more recent methods followed in this branch of

instruction consist of a "U" shaped arrangement of tables, seating two pupils per table, and with one or more demonstration tables in the center of the "U." A gas main circles around and supplies two stubs for each table, used in connection with portable gas plates, the size of which vary somewhat. Any table approximately 30 inches wide, five feet long and 32 inches wide, will do for a unit. These tables are built with white maple tops and sliding shelves, cupboards and drawers underneath, and may be a piece of furniture or built to order.

Other equipment for this room will consist of a range, towel rack, ice box, sink, cupboards, china closet and pantry cases. Lockers for each pupil must be provided for in some manner. A serving pantry and dining room may be incorporated in the larger schools.

DOMESTIC SCIENCE (Sewing)

Sewing is taught in different ways, depending upon the number of pupils taking up that branch of study. The tables may be arranged after a fashion similar to cooking tables, or they may be placed in two aisles, leaving a center aisle for machines, one to every four pupils. The tables should be 32 inches high, 60 inches long, and from three to four feet wide, fitted with extension leaves, sliding shelves and drawers. Lockers will be required for each pupil, and material and supply cases. A display wardrobe with glass doors will be desirable.

LUNCH ROOMS

In all high schools, lunch rooms are provided for, cafeterias, etc., in some instances, operated entirely or in part as a feature of the domestic science group and preferably located adjoining or near that department. Provision is so made that pupils may get their lunches entire or in part, at cost. It will not be found a paying proposition to operate a cafeteria excepting in very large schools; in fact, but few instances may be cited where expenses were covered for such department.

DRAWING ROOMS

High schools usually require free-hand and mechanical drawing rooms, and if both subjects are taught by the same instructor they may be well placed adjacent. Both rooms require ample light, preferably from the north, and skylights are desirable if not necessary, to both. For this reason they are often placed on the top floor of the building, although mechanical drawing is often more or less supplementary to shop work. If taught by the latter instructor it might be more conveniently placed near the shops, which, of course, usually means the ground floor.

The free-hand drawing room should be of sufficient size to accommodate its occupants and provided with a closet for models, easels and numerous other objects to be stowed away. A shelf for models, 18″ wide and 2′6″ from the floor, should be secured to the walls around all sides of the room, hinged at the top

in sections so as to be folded away when not in use. A wood strip may be built into the walls at various heights, flush with the plaster, to support objects, casts, etc., and as a wall covering such as burlap, monk's cloth, etc., is usually put on the walls of the drawing room, these strips are covered from view, though accessible for the purpose for which they are intended.

The mechanical-drawing room must have cases and lockers for instruments, materials, and drawing boards, the size of which may be obtained from catalogues from the manufacturers furnishing such articles. In addition to the room proper, a closet for supplies and a small room for blue printing will be desirable. Blackboards are not necessary in either free-hand or mechanical drawing rooms, other than a movable board for demonstration by the instructor. Drawing tables are best when made of the pedestal type, as that variety is rigid and easy to clean. The height of such fixtures is regulated by a hand screw, which is adjustable, as well as the angle of the board itself, which is supplemented with a swing arm shelf for placing instruments, etc.

In the larger and better equipped drawing rooms each pupil will own his own instruments, and a case of small lockers will be required in which to keep them locked up when not in use. A rack for small drawing boards of a uniform size is also required.

MANUAL TRAINING

The introduction of manual training in many of

our modern schools requires special rooms, the former being best located in the basement of a sufficient ceiling height to allow for an abundance of light. When placed there, any noise or vibration which cannot be eliminated will be reduced to a minimum and little or no inconvenience on that account will be found in the class rooms above. There can be no standard sizes of rooms for manual training, as some schools make a specialty of this subject, while others elaborate somewhere else. In general, the rooms should be well lighted and arranged conveniently near, or adjoining, a supply room, tool room (wash and locker room if possible), and a room for instruction, the latter often at the end of the room proper. A room 24x40 feet might be the minimum size.

In the larger schools, four shops are considered sufficient for instruction, namely, wood turning shop, advanced wood working shop, forge shop and machine shop. They may be grouped together or separated, as the plan will admit, but when grouped together a more economic arrangement will generally be found with respect to wash rooms, locker space, concentration of noise, equipment, etc. Salt glazed brick or glazed tile is a desirable material for wall surface, as it is not porous and may be readily cleaned.

The floors may be of concrete or wood, the former preferred for the machine shop.

The ceiling must be especially constructed if lathes or other machinery be operated by shafting suspended from them, otherwise vibration or insufficient strength may materialize. Conduits for motors and machinery

must be made before the building is too far completed to properly place them without disfigurement.

Manual training rooms should be well lighted, and it is a mistake to place them on a mezzanine or exceptionally low basement, because a nearly horizontal light is very trying at a work bench. They require high, level lighting as much as the class rooms, but on account of their secondary importance in comparison of use, ideal conditions are not always met with.

Wood working benches will vary in size, according to manufacture, the average sizes being from 14" to 20" in width, 4'-0" to 6'-0" in length, and a height of 32" and 34" from top to floor. They are equipped with vice and flush cabinet makers, tail vice, and may open under top or be furnished with tool cases and drawers, as desired. Where two or more sets of pupils use the same benches, each scholar is supplied with a set of the more elementary tools, which he keeps locked up, and for which he is held responsible, as to condition and safe keeping.

In the advanced wood working shop the equipment will be different, and the classes smaller, although as great a floor area as for the wood turning shop will be required. Large work benches will be used, and possibly a band saw, planer, edger, sticker, circular saw and other machinery will be installed, most of which will be electric driven.

The forge and machine shops will be equipped with miscellaneous machinery, similar to that found in any complete machine shop. All shops will require lockers for each pupil receiving instruction in that department.

GYMNASIUM

The gymnasium may be used for drills or athletic pursuits of various kinds, and is located preferably near the grade. The size of classes will vary from 50 to 100 pupils. In some of the Eastern States high schools instruct the boys in military discipline, and when such is the case the gymnasium must be at least 4000 square feet in area. Whatever be the size, the customary arrangement of this room is such that a narrow gallery or mezzanine runs around all sizes to be utilized for a running track or for seating purposes during exhibitions, etc.

The importance of a gymnasium and its equipment may be determined by the size of ground available, amount of funds and size of the school itself. Where abundant ground area is to be had, as it often is in some sections of the country, and the school enrollment is not large, a gymnasium may well be dispensed with entirely and a small separate building constructed containing team rooms, showers, etc. Such a building may be connected with the main building by a covered collonade or cloister and featured architecturally, if desirable.

The cost of a gymnasium of suitable height (24 feet) incorporated in the school building itself, is considerable, and need only be supplied when sufficient regular use warrants its provision. It might be said that no high school (with comparatively ample grounds) housing less than 500 pupils need have a modern gymnasium incorporated with the building

itself. In large cities where the occupants can get exercise in no other way it is indispensable.

GYMNASIUM (Additional Rooms)

The management of a modern gymnasium and the other athletic interests of the school will require an instructor for whom a small adjoining room will be necessary. Lockers and dressing rooms are needed, preferably on both sides of the gymnasium (one side for girls, the other for boys), and shower baths. Each pupil will have a separate locker which will contain his athletic wardrobe, towels, etc. These may be of the ventilated metal variety, two tiers high and operated by keyless locks.

GYMNASIUM (Equipment)

This may be as elaborate as funds will permit and bears little relation to the architectural requirements.

EQUIPMENT

Equipment for installation in a high school building may be divided into two general classes. The first include steachers' desks and chairs, tables, recitation seats, auditorium sittings, library and administration furniture and commercial desks. The first class differs from the following class chiefly in that the items can be purchased as regularly made "stock" articles, and require no special design nor adaptation. Such equipment is generally arranged for by a separate ap-

propriation and has but little to do with the architectural features of the building.

The second class belongs to the building proper, and consists of equipment which is more permanently placed and must be provided for, or especially designed, as program clocks, electric bell systems, intercommunicating phones, hose reels, teachers' cabinets, laboratory, demonstration and work tables, balance counters, wall cases, storage cupboards, benches, hoods, cabinets, etc. These items belong chiefly to what might be called the work rooms or laboratories, and are not required in the regular session and recitation rooms. Lockers may be included in either class, preferably the latter, as the height of windows may effect their location somewhat. (See laboratory and shop equipment under separate headings.)

METAL LOCKERS

Metal lockers may be obtained in almost any size or height for single or double tiers. The following sizes are those that are readily found in stock at any of the numerous concerns manufacturing such articles:

Single tiers.

12 x 12 x 36
12 x 15 x 36
15 x 18 x 36

Double tier.

12 x 12 x 60
12 x 15 x 60
12 x 15 x 60
15 x 18 x 60
18 x 18 x 60

These articles are well made, sanitary in every respect and vermin proof. No wood locker can compare in any way mith them other than original cost, as they do not need repainting or repair work for several years, being practically indestructible. Combination locks are preferred to others.

HEATING SYSTEMS

The kind of heating apparatus for any school will necessarily be determined by the size of the building, compactness of plan, climatic conditions, fuel most readily obtained and other elements affecting not only its installation, but the upkeep.

For small schools of eight class rooms and less, in a mild climate where wood, coal or oil may be readily obtained, good results are procured by the use of hot air furnaces, in conjunction, of course, with a mechanical ventilating apparatus which forces the air, either heated or otherwise, into the class rooms at a uniform temperature and quantity. The advantage of such an apparatus is cheapness of installation and upkeep, as no engineer need be employed to run the apparatus, and heat is quickly obtained with little cost.

In large buildings the same system may, in some few instances, be used in mild climates. Where freezing weather is encountered, it will generally be found more economical and practical to use steam apparatus in connection with the mechanical ventilation for any building over eight class rooms in size, and often in those of a lesser number of class rooms. A steam in-

stallation is more expensive to install and operat, unless in use most of the time, in which case it will be found more economical than others.

The modern high school building of 400 pupils or more will (in 90% of such buildings) be heated by steam, in which case the mechanical ventilation apparatus is used in all the principal rooms. Steam may be used direct in some rooms, as may be advisable, but class rooms are heated indirect in almost every instance. The upkeep is not so seriously considered, for an engineer is an essential factor in buildings of this class to care for dynamos, motors, pumping plants, etc., which are customarily installed in addition to, or in connection with the heating apparatus.

In some of the new high schools in the larger cities the mechanical equipment is quite elaborate and entirely beyond the scope of this work. The requirements are extensive and require the assistance of mechanical engineers familiar with such work.

HEATING AND VENTILATING

"The importance of adequate artificial ventilation cannot be exaggerated, and modern school buildings are, as a rule, much better equipped in this respect than was formerly thought necessary. But it must be remembered that though artificial ventilation is always an expensive luxury, both in first cost and in operation and maintenance, it is, in practice, inseparably connected with the problem of heating, though the

two functions are in theory wholly distant and independent."

A modern mechanical heating and ventilating apparatus consists of a heater, radiating surface and a blower, which blows the air over or from the radiating surface through ducts to the outlets of the various rooms. From here, being under pressure, it escapes through ducts to the various rooms and thence up to the roof.

The principle is the same, no matter what medium is used to procure the results, whether hot air or steam be used, or whether the heater is fed with oil, coal or wood. There are many different kinds of mechanical heating and ventilating apparatus for schools, but they differ in detail, not in principle.

Many not informed on heating and ventilation are confused by thinking that a steam heating plant for a school building cannot serve for mechanical ventilation the same as other kinds, but such is not the case, most buildings now being arranged so that both are in operation from the same plant at the same time.

The heating apparatus should, when possible, be located near the center of the building, though it is not necessary from a mechanical standpoint. When so located, the runs of pipe will be of more equal length in all directions and the system more noiseless in operation. Long runs are successfully taken care of, but at greater expense and higher velocities.

AMOUNT OF AIR REQUIRED

The following requirements were outlined by the Commonwealth of Massachusetts some thirty years ago and been practically standardized by the Federal Government and eight States of the Union.

"(1.) That the heating apparatus, properly managed, would heat all rooms to 70 degrees F. in any weather; (2) that with rooms at 70 degrees and a difference of not les than 40 degrees between the temperature of the outside air and that of the air entering the room, the apparatus would supply thirty cubic feet of air per minute for each scholar in the room; (3) that such supply of air would so circulate in the room that no uncomfortable draft be felt, and that there should be no greater variation than 3 degrees in any part of the room on the same breathing plane; (4) that an equal amount of air to the supply leave the room through exhaust flues; (5) that the sanitary arrangements be properly ventilated and (6) that the working of the apparatus be guaranteed."

Although the above outline is unquestionably more or less antiquated and inconsistent with the more advanced theories and ideals of the present day, especially with refrence to the humidity and quality of air supplied, no changes of importance have been adopted to any extent.

The fundamental principles underlying the requirements for the ventilating of all class rooms require 30 cubic feet (or a trifle under one metre cube) of fresh air per minute for each pupil, up to the maximum num-

ber allowed for the room in question; while the heating plant should be adequate to raise the temperatures of all rooms, exposed or otherwise, to 70 degrees Fahrenheit in the coldest weather that might occur.

The average school room being 24 x 32 feet in size, with a ceiling height of 12½ feet, will contain 9800 (approximately 10,000 cubic feet), which air must be changed from six to ten times per hour, according to opinions of heating engineers. Six changes representing a minimum and ten changes being considered as being ample for ventilation of the highest standard. Assuming the average number of changes of air per hour, 80,000 cubic feet per hour would be required for such a room. Precisely the same quantities may be arrived at by assuming 45 pupils occupying a standard room, each of whom is to be provided with 30 cubic feet per minute, 30 x 45 x 60 would equal 81,000, or the number of cubic feet per hour. These conditions apply to class rooms, and so far most engineers will check; however, assembly halls, corridors and main rooms are heated and ventilated by a different formulae, in some cases omitting part of the heat, but not diminishing the ventilation, or a combination of the two.

The assembly hall may be heated by direct radiation (usually steam coils or radiators) if it has plenty of large windows, doors, etc., to assist ventilation, in addition to more or less forced ventilation, or it may be heated and ventilated by tempered air as for class rooms. The use of the room generally determines the system to be used for assembly halls, which are fre-

quently used for large gatherings and will require little heat after once being occupied, but a great amount of ventilation.

Foot warmers are located in the entrance corridors of most schools, and sufficient heat is given forth from them, if they are properly placed and of ample radiation, to keep the corridors sufficiently warm. They consist of a register face, or similar grating in the floor, through which the heat passes. In some cases they are fed by tempered and fresh air from the plenum chamber, and in other arrangements for steam heat they consist of a set of steam coils through which air passes out of and into the corridors.

HEAT VENTILATING DUCTS

The location of heating and ventilation stack and groups of flues are not always placed most theoretically correct in the room, due to economic reasons that govern them, to a certain extent. Flues or ducts cannot come up in a room indiscriminately, and care is taken to have them adjacent to one another, concealed, leaving the wall flush and without projection. This involves considerable ingenuity of the architect's plan and utter disregard to them would seriously disfigure an otherwise suitable floor plan. They must be so placed as to insure a complete circulation of air and heat throughout the room, which means that the outlet is best placed on the same side of the room as the inlet, the heated air being blown into the room under pressure and scattering in different directions, to be

picked up finally near where it originally entered. The heat outlets, or rather "heat inlets to room," are of various sizes up to 24"x30" in area for a standard class room and located 7'-6" above the floor. The face of heat inlets consists of a register face finished to match the hardware, or simply an iron wire grating.

The vent flues from the sanitaries should be carried up separately to the tops of the main ventilators and should be so located that the horizontal runs, particularly from the fixtures in the basement, are as short as possible. In some instances these vents are accelerated by a small electric motor-driven fan, operated independently from the main ventilating system.

LOCATION OF FAN, FRESH AIR INLET, ETC.

The school house being ordinary symmetrical, it is well to place the fan so that the discharge will lie along the axis of the building, and thus deliver an equal quantity of air in either direction. The primary chamber, which naturally adjoins the fan room, ought to have the fresh air chamber inlet so located above ground that dust, leaves, etc., cannot be drawn in. It is preferable to have the intake over a grass plot and at the rear of the building if to avoid a dusty street. In any case, the architect will, of course, avoid placing it near the toilet vent outlets or the chimney.

MAIN DUCTS

The horizontal galvanized ducts radiating from the fan in connection with the plenum system are often

carried on the basement ceiling, which is furred down to conceal them and plastered. Another method is to run them beneath the basement floor, making them of brick or concrete and eliminating the furred ceilings, the former being practiced where plenty of ceiling height is available in the basement corridor, and the latter if to the contrary.

When built of masonry, care must be taken to have the joints on the inside laid as smooth as possible and the proper formulae used in figuring, due to loss by friction, which is bound to be in evidence. Galvanized iron ducts are used almost exclusively for the conveyance of air and all changes of direction made with easy curves.

AIR WASHER

An air washer is used with heating plants for large installations, or in cities where a considerable amount of soot, dust, etc., is encountered. The apparatus consists of a fine spraying device through which all the air is passed and which catches solid matters of any sort. Where the air intake is high enough up from the ground, and the surrounding air is clean and fresh, no air washer is necessary, and its use may be well dispensed with, as it consumes considerable water, the principal cost of its upkeep.

SANITATION

(See toilet rooms for number of fixtures.

Modern fixtures are utilized almost exclusively

now in school buildings, and no other types need be mentioned here other than those, the unsanitary range closets being used only in the cheapest of buildings. Modern fixtures consist of individual fixtures—in some cases more properly termed individual units in batteries—and in either case the bowls are white vitreous or semi-china glazed ware.

For separate fixtures, a wash-down bowl with syphon action or jet will be found adequate, and if a sufficient water surface is provided for, proper vent and depth of seal obtained, either type will give satisfaction. The operation of fixture may be by pull (chain or rod), valve or seat action, the latter being used almost exclusively as it insures a flush automatically and prevents a minimum number of exposed parts to be tampered with. There are a great number of different manufacturers of plumbing fixtures, each putting on the market practically the same products at practically the same prices, although it is commonly expressed that "So and So's" fixtures are the best. As a matter of fact, almost any manufacturer of plumbing fixtures can give you any type of fixture at about the same cost as manufactured by others. The only difference will be found in details that only one of experience can determine. The average school board can well leave the selection of plumbing fixtures to the architect, provided they insist on the **above requirements**, and that the fixtures specified are eventually installed.

Fixtures are usually arranged in groups, back to back, with a utility chamber between, of 24″ in width,

in which the tank or tanks, pipes, etc., are placed, and in some cases this space is used as a vent.

Stall partitions can be of any size and any material —wood, slate, plaster, composition or marble. A good material and a cheap one is being extensively used, consisting of a metal frame reinforced with light iron channels, covered with metal lath and plastered, the exposed sides being finished with Keene's cement. This makes a partition 2″ in thickness, absolutely rigid, and when painted as non-porous and sanitary as any other material except metal or marble.

The partitions are set about 12″ above the floor and extend to 5′-6″ except at the back where partition runs full height (6′-6″) from the floor and is roofed over the utility chamber. Doors may be used or not, as desired, although it is customary to omit them in grammar schools. When used they are short doors hung on spring butts and rarely provided with locks.

Urinals for grammar schools are still unsanitary fixtures, and probably always will be, for while modern fixtures have been improved upon in every conceivable way, carelessness on the part of the user cannot be overcome in a public building. Care should be taken that the back is of non-porous material, that it is well flushed at all times, that the foot trough is enameled ware and well flushed, trapped and ventilated. The fixture may have partitions or not, and if so, they must also be of non-porous material. Separate urinals with automatic flush are usually installed in high schools, and there are manufactured at the present time white porcelain units—back, sides and troughs, with a min-

imum number of parts—that are theoretically perfect as far as manufacture is concerned, but which are too expensive and not far enough in advance over the separate lip urinal to warrant their use in public schools.

DRINKING FOUNTAINS

Drinking fountains are now manufactured of the porcelain or metal "bubbling cup" pattern, either separate fixtures with a porcelain pedestal or units of two or more, arranged over a porcelain sink with a high back. Drinking cups are of the dark ages, and the old type is not to be considered; in fact, they are prohibited by law in the States of Massachusetts, Wisconsin, Illinois, Kansas and Oaklahoma.

SHOWERS

Showers for gymnasiums or play rooms may be as elaborate as desired. The simplest form would be merely a spray and drain in the floor, screened off from the dressing room, and which would cost practically nothing; both spray and pipe galvanized. More satisfactory fixtures would be stalls 3′-0″ x 3′-0″ in size, with non-porous sides and back, with sprays and mixing chamber (hot water should be provided for) and dressing rooms, either one room with bench or separate stalls. Marble is the most attractive material to use for stalls, sides and floors, but composition will be found suitable and much cheaper. The size of the school should determine the elaborateness of its fittings as far as showers are concerned, for if hot water

is supplied, provision for it will be much cheaper in comparison in a large school than in a small one. Hot water is supplied by a tank with steam coils, a simple proposition where steam is used in other parts of the building. Otherwise, a separate apparatus may be installed, automatic and using gas as a fuel.

STAND PIPES

In a fire-proof building these are not necessary, as what furniture, papers, etc., that might take fire may be easily extinguished without the use of water. Where wood is used in any part of the construction or trim, stand pipes are run from basement up through the roof at such places as may readily lend themselves to a 60-foot run of fire hose. The stand pipes should be at least 2″ in diameter, with 1½″ outlets at each floor and roof. Hose reels are made in many different patterns and can be set in the wall and covered with a glass case flush with the plaster. In any case the hose should be overhauled at least once a year, as it is likely to crack or rot where folded.

ELECTRIC LIGHTING

Some school buildings will require very little artificial light unless utilized for night school. Buildings having assembly halls will require more or less elaborate lighting, including corridors, entrance and toilet rooms.

It is well to provide ample wiring for all rooms, which, if not utilized, will be in place when desired

without having to be installed at a later date and at a much greater cost and often with considerable disfigurement to wall and ceiling surfaces.

The class room ceiling lights are usually of the chandelier type, very plain and substantial, as they are difficult to clean and unsightly when otherwise. Holyphane reflectors are used, the fixtures operated by flush-plate switch. Indirect lighting is very desirable in class rooms, as no fixtures are required from the ceiling. However, it is quite expensive, requiring more light equivalent.

Corridor lights may be enclosed in an opalescent glass half-dome, set against the ceiling. These fixtures will require no cleaning whatever, and are of decidedly neat appearance.

The assembly hall may have side brackets and indirect lighting around the ceiling treatment, eliminating suspended fixtures entirely. The stage may have platform and proscenium lights, which are also concealed and operated from a cut-out box located in an adjoining dressing room. All fixtures in this room should be controlled by cut-out switch, as there may be times when it is desirable to cut out all lights, for stereopticon, moving picture apparatus, etc.

ELECTRIC WIRING

In connection with wiring for lights, additional wiring is required for installation to motor for ventilating apparatus, stereopticon or similar apparatus for assembly hall and science lecture room, or both,

physics laboratory, for motors in shops and for other special purposes. The location of cut-out boxes, panel boards, switches, arrangement of wiring, etc., will require the assistance of an engineer and detail of much importance, but out of the scope of this work.

TELEPHONES

Inter-communicating telephones are installed in all modern buildings, and their cost is an incredibly small item. The instruments for the teachers are placed on the wall of the class rooms, and those in the principal's offices are of the desk pattern. Each instrument has a push button box with buttons for all stations, so that communication may be had direct to any station without the use of an exchange or an operator of any kind. The entire apparatus may be connected to local city service with small additional cost.

PROGRAM CLOCKS

Program clocks are operated by electricity, compressed air, weights or springs, any of which are made self-winding, and the ordinary automatic apparatus consists of a Master's clock with secondary clocks for as many rooms as is desired, which, in addition to furnishing time instruments for school purposes, operates one or more programs by ringing bells in the corridors, shops, etc., at whatever time they may be set for. One program is usually enough, but additional ones may be added to any of the apparatus with little cost. By using a modern program clock, each class room

may have a neat flush plate dust-proof dial of the same pattern, and no conflict can occur from variation in time in different parts of the building. Winding is entirely eliminated; in fact, the apparatus has been sufficiently demonstrated practical and of reasonable enough cost of installation for any modern school.

VACUUM CLEANING APPARATUS

The vacuum cleaning apparatus has made such rapid strides in its mechanical efficiency that it may be safely said that no modern school building should be constructed without at least making provision for piping during construction. This cost is insignificant in amount and will eliminate a later installation with exposed piping, and more or less patching of ceiling, etc.

An apparatus of appropriate design, properly installed, affords a practical method of dustless school cleaning, a method that by a mechanical suction actually picks up the dust and dirt from the floors, furniture, chalk rails, walls, etc., and deposits in suitable receptacles.

Portable machines are entirely inadequate for a school building, except in buildings of less than four rooms, where their use may or may not be considered satisfactory, therefore their use need not be discussed in detail here.

On each floor the piping has one or more outlets to which flexible hose can be attached, of sufficient length to reach all parts of rooms to be cleaned; the tool and handle vary, according to the character of

cleaning to be done, whether floor, wall, ceiling, furniture, etc.

SIZE OF PLANT

Vacuum cleaners of the stationary type vary in size from the smallest or "one-sweeper" plants to as large a plant as may be necessary to permit the cleaning of a large building by a force of several janitors. The usual term describing size is "one-sweeper," "four-sweeper" or "twelve-sweeper," according to the number of floor brushes that can be simultaneously operated.

Few school buildings except in the larger cities, will require more than a one-sweeper or possibly a two-sweeper plant, and no attempt will be made in this article to consider larger units, since they assume the proportions of engineering problems, and no school board should attempt their installation without the assistance of competent consulting engineers.

Permanent piping should be installed, concealed in partitions, taking care that outlets and cleanout openings are extended through partitions, and may be of the ordinary commercial iron or steel pipe arranged, so far as possible, in vertical risers with a minimum of horizontal runs.

It is necessary to have outlets in every school room, and the location in corridors should be selected with reference to school room doors.

Outlets or hose connections are flush with baseboard and are nickle or finished to correspond with other furnishings.

HOSE

Fifty feet of hose is a convenient length and seventy-five feet is not impossible. The hose may be of rubber or metal covered, and hose smaller than one inch, inside diameter, is not practical, larger than one and one-half inch is too cumbersome. Whatever the variety is, it should come in twenty-five-foot lengths and have convenient air-tight couplings.

TOOLS (VACUUM CLEANING)

In some school rooms, with the ordinary type of school desk attached to the floor at four points, the use of vacuum cleaner tools is attended with some difficulty, therefore, especially designed shapes are required to work around desk legs. Sanitary furniture with single pedestal desks and seats, is ideal for vacuum cleaning, and larger cities are gradually adopting this type of seat. The particular type of tool to use depends on the surface to be cleaned. For smooth, bare floors, tools are less efficient than on comparatively rough surface. In general, they are from ten to eighteen inches long, and perhaps three inches wide. Felt pads or rows of bristles serve to prevent too great an admission of air and to localize this admission of air where the inrush will draw up the dirt and dust. For walls and chalk trays, a circular brush with long bristles and leather cuff is advisable.

SCHOOL LAWS (Building, Etc.)

In Germany, France and England, all public instruction is carried on in buildings very exact in requirements, construction and convenience, and in the United States some States have definite laws in this respect, patterned more or less after the Massachusetts State law, which is a standard so far in this country. The time is not far distant when all States will have laws and regulations which will be practically uniform in each, not only with reference to the construction, arrangement, sanitation, etc., of school buildings, but in the matter of method of selecting the architects' competitions, etc. The principles of school planning are comparatively uniform for all parts of the country, varying only in detail, due to climatic conditions and the public's standard of ideals. For those interested, reference may be had to the school laws of Massachusetts, New Jersey, Connecticut, New York, Pennsylvania, North Dakota, South Dakota, Utah, Vermont, Virginia, West Virginia, Ohio, Kansas, New Hampshire and Minnesota.

Other States have laws relating to fire-escapes and minor details with reference to school buildings, but no complete or modern rules and regulations.

COMPETITIONS

Competitions are conducted by private and municipal bodies for the supposed election of an architect, who, by the terms of such competition, successfully demonstrates that he is more fitted for the purpose of

preparing plans and specifications of suitable design, than his fellow contestants. In many communities competitors are required by law or custom, and it is quite likely that they will continue to be utilized for such a purpose for some time to come, with, fortunately, many of the unsatisfactory conditions eliminated that are now incorporated, and more sane ones substituted.

Any public community supporting a new building proposition is entitled to the most artistic and skillful conception of such improvement.

When a new building is needed, it is the duty of those in charge to select an architect either by competition or otherwise, who is best fitted for the purpose. If, by competition, the program for such must be drawn up in such a manner as to place all competing architects on an equal basis, and a selection made under careful advisement by some competent and disinterested architect of sufficient professional standing as to be beyond public criticism. The municipal laws in some localities require that the members of the governing body (supervisors, school trustees, etc.,) must select the architect, and such being the case, they have the opportunity of securing as much professional advisement as they may desire.

Successful men in any vocation of life are capable to a certain extent of handling the problems that arise in their own professions and business, and should readily recognize a skilled architect's ability to perform his services in a professional manner to the extent that, assuming a competition has been conducted in a

proper manner in the preparation of preliminary plans, a selection should be made only under the careful advisement of a consulting architect who has sufficient knowledge at his disposal to show how and why one or more plans, etc., are best suited to their needs, and conforming strictly to the program as called for.

In no other way does a so-called composition fulfill the end for which it was intended, namely, to select the architect most fitted for the work at hand, for, owing to the fact that the commissions of all reliable architects is the same, no other qualification is intended in a competition.

No architect of good standing will enter into a competition which is not conducted in such a manner as to allow him to compete on an equal basis for selection as that of his contemporaries, and if the architects do not compete on an equal basis, time and money is wasted by both municipality and themselves, and a better way of procedure would be to select him without competition.

When a board cannot make a selection outright of an architect for various reasons, and decides that a competition is necessary, they may dodge absolute criticism by conducting it in the most approved manner.

The American Institute of Architects supplies "Public Information," on the conduct and arrangement of competitons, which, if followed, will insure a most fair method of procedure for the municipality and one under which no architect in good standing will hesitate to compete under.

Our National Government, and all of the large cities, conduct competitions after the outline as recommended by the American Institute of Architects, and it is only in some of the remote districts where competitions occur very rarely that they are conducted otherwise, and then from lack of proper information on such subjects.

The American Institute of Architects do not assume to dictate the conduct of competitions, but aim only to assist by advising the adoption of such methods as long experience has proven to be just and wise; in brief, they insist in general on only two requirements. First, that competing architects shall be given the opportunity to compete on an equal basis; second, that the selecting body have professional advisement of recognized standing in making the selection. They do not discriminate against any individual, whether he be a member of their institution or otherwise, and any public body or individual may obtain, gratis, printed information desired on "Competitions," by mere request from "The American Institute of Architects," Washington, D. C.

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